The Role of Agriculture in the Evolution of the Pre-Contact Hawaiian State

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TERRACES FOR THE IRRIGATED CULTIVATION of taro once occupied a significant area within every major stream valley on O'ahu. Taro pondfields (*lo'i kalo*) were particularly numerous in Kailua and Kāne'ohe *ahupua'a* (traditional land divisions) in Ko'olau Poko District, on the windward side of the island (Fig. 1). Both of these *ahupua'a* were of central importance to early rulers: Kailua had once been the capital of O'ahu; and Kāne'ohe was so favored by Kamehameha I that he retained the land division as his personal property when other conquered lands were distributed to his soldiers and retainers in 1795 (Devaney et al. 1982:5).

Both areas figured importantly in economic and political developments prior to European contact (pre-A.D. 1778). This article applies agricultural evidence from Kailua, Kāne'ohe, and other valleys to research questions concerned with the evolution of the pre-Contact state system of government in Hawai'i.

THE PRE-CONTACT HAWAIIAN STATE

According to oral historical information transcribed in early nineteenth-century histories (e.g., Kamakau 1961; Malo 1951), Hawaiian sociopolitical organization prior to EuroAmerican contact was among the most complex in Polynesia. Hawaiian society and political institutions originated in ancestral Polynesian forms (e.g., Kirch 1984; Kirch, ed. 1986) but had evolved into a system that has traditionally been described in the anthropological literature as a chiefdom (e.g., Sahlins 1968) or a pre-state complex society (e.g., Cordy 1978).

The available evidence indicates that each of at least three polities (on O'ahu, Maui, and Hawai'i islands) had undergone the transformation from chiefdom to state approximately two centuries before European contact. Hommon (1976, 1986) refers to these polities as primitive states. As is discussed here, they satisfy the criteria cited by most researchers for true states, albeit early and certainly still evolving.

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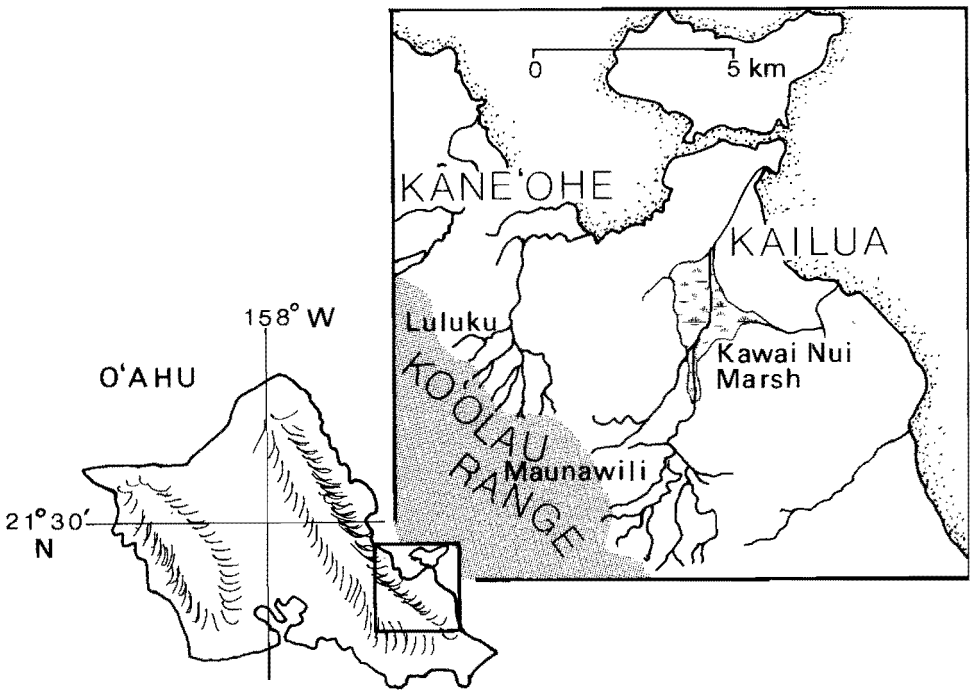

Fig. 1. Agricultural site locations: Luluku, Kāne'ohe *ahupua'a*; Kawai Nui and Maunawili, Kailua *ahupua'a*. Ko'olau Poko District, O'ahu.

First, Hawaiian polities at Contact constituted autonomous political units, each encompassing many communities within its territory and having a centralized government with the power to collect taxes, draft community members for work or war, and decree and enforce laws (Carneiro 1970:733). Each polity had formed in a complex society with a social hierarchy as a permanent institutional feature, but each was by now structurally more complex than a chiefdom or simple rank society, with an elaborated *political* hierarchy incorporating two or more ranks above the producer (Athens 1977; Hommon 1986:58; Peebles and Kus 1977). Each level of the hierarchy possessed a specialized administrative structure that processed information and effected control over the society, producing a geometric increase in social control and economic centralization at each level (Kamakau 1961; Malo 1951; Sanders 1974; Service 1975; Steponaitis 1981; Wright and Johnson 1975).

Hawaiian rulers as they are described in the earliest available ethnographic records, oral historical literature, and legends did not persuade their followers with gifts—a characteristic attributed to chiefdoms (Webb 1974:369)—but rather commanded or coerced them. The need and ability to command or coerce define a significant change in the acquisition of power from ascribed status within a kin group to an achieved status that transcends and overrides kin alignments. This power shift is a critical mechanism that distinguishes the state system of government from its predecessors in ranked society (Carneiro 1970; Hommon 1976). Facilitated by coercion and commanded allegiance, the collection of rent and taxes replaced distribu-

tion and gift-giving in Hawai'i as polities were transformed into states. Warfare increased as state-based rulers attempted to enlarge their territories.

Based on linguistic and historical evidence, central Polynesian societies had evolved into socially stratified, rank societies before the first settlers of Hawai'i left their homeland c. A.D. 500 and voyaged to the Hawaiian Islands. Certain rank structures documented for Hawai'i are also known from other Polynesian island groups (Bellwood 1979; Kirch 1984). Other central Polynesian concepts, such as traditional ties linking kin groups closely to specific land units, also contributed to the emergence of the Hawaiian state system.

The main characteristics of the Hawaiian states, as they are described for the Contact period, however, show unique attributes that apparently developed in Hawai'i. The evolution of the Hawaiian states remains a subject of considerable interest to researchers concerned with the emergence of complex societies in various areas around the Indo-Pacific basin during the first 1500 years A.D. (e.g., Allen 1988, 1990*a*, 1990*b*; Bellwood 1979; Cordy 1981; Earle 1977, 1978; Higham 1989; Kirch 1984; Kirch, ed. 1986; Marr and Milner 1986).

THREE MODELS FOR ECONOMIC AND POLITICAL CENTRALIZATION

All states, whether primary (independent, "pristine") or secondary (colonial or otherwise derivative), demonstrate greatly enhanced centralization of power. This centralization of power is a critical component in the three most convincing anthropological models for the evolution of complex societies around the Indo-Pacific basin—those that emphasize the roles played by population pressure, exchange, and intensive agricultural technology in fostering political complexity.

Population pressure often produces increasingly efficient, centralized organization of both the people and their subsistence base, especially where resources are scarce or circumscribed (e.g., Carneiro 1970; Kappel 1974).

Exchange, in exchange-based societies, brings about centralization and redistribution of goods and information, which has in turn traditionally led to the centralization of political authority (e.g., Earle 1977; Hutterer 1973; Kennedy 1977; Wolters 1979).

Irrigation technology and coordinated water use generally require centralized administrative structures. These structures have apparently evolved into effective political structures in areas including Andean South America, Mexico, the Middle East, Sri Lanka, China, Japan, Southeast Asia, and the tropical Pacific (e.g., Downing and Gibson 1974; Spencer and Hale 1961; Wittfogel 1957).

Regardless which specific configuration of traits produced them, economic and political centralization are critical, and early, processes in state evolution. They have, however, been difficult to document archaeologically in Hawai'i. Although, for example, pre-state centralization is reflected in many areas of the world in settlement-size hierarchies that suggest differential tribute control (e.g., Steponaitis 1981), Hawaiian settlements tended to be somewhat centralized only very early, dispersing during the periods that directly preceded state development (e.g., Kirch 1985:34–35, 127–129; Kirch and Kelly 1975).

Most Hawaiian evidence for centralized control (e.g., monumental *heiau po'o*

kanaka—human sacrificial shrines; battlefields; walls delineating land divisions) dates either to the latest pre-Contact period or the post-Contact period, when the states were fully developed or even deteriorating. The processes and sequences of events that produced the traditional Hawaiian state in the first place remain imperfectly understood.

Empirical evidence for pre-Contact population numbers is scant: burial grounds are imperfectly dated; site numbers, although they suggest shifts in population sizes for certain areas (Hommon 1976), are not yet well enough documented or chronologically controlled throughout the Islands to permit comparisons of general population sizes at specific periods. A third data set once considered proof of dense populations—evidence for the pre-Contact production of large amounts of taro—now appears more likely to reflect primarily other needs, to be discussed.

Extraregional exchange models, which apply well to many Indo-Pacific states (and earlier cultures, including Lapita), do not explain centralization in Hawai'i, where no extraregional exchange networks are known until A.D. 1778. The possible role played by interisland exchange within the archipelago needs serious attention, to include petrographic sourcing of lithic items.

Direct archaeological evidence for the evolution of the Hawaiian states, in terms of population increase, external exchange, or alternative models (e.g., secondary state development after the arrival of Tahitian élites) has been elusive.

Two rarely explored elements in the state development models outlined above—the coordination of internal exchange and the administration of irrigated agriculture—appear more promising for Hawaiian research. The explanatory potential of exchange is suggested by specific processes modeled in Hommon's (1976) dissertation, which presents both ethnological and historical information and also the (scant) archaeological evidence that was available in the early 1970s.

One of the most important components of Hommon's state development model is the early development of *mauka–makai* (mountain-to-sea) socioeconomic networks, which both integrated social life and provided to the individual consumer products from a diverse range of habitats. Other changes that participated in the transformation to the state included the replacement of kinship-based landholding groups (archaic *maka'āinana*) by corporate groups associated with *ahupua'a*—which are aligned *mauka–makai* and offer a broad range of resource zones for exploitation; the disintegration of economic reciprocity between chiefs and commoners, with increasing economic and other controls exerted by the former over the latter; the decline of kinship as the social mechanism that integrates society and its replacement by a centralized political structure; the eventual replacement of an economy integrated by redistribution and tribute by an economy that emphasized taxes and rents; and the expansion of territories through force, which was effected by a governmental monopoly of power.

Agriculture was apparently an integral component in each Hawaiian *mauka–makai* network from colonization on. Although the extensive terrace systems that occupy most major valleys in the Hawaiian Islands were once considered a late phenomenon, recent findings indicate that, at least on O'ahu, some were in use by the fifth to seventh centuries A.D., predating the emergence of the state and even the *ahupua'a* system by many centuries.

Centralized collection and redistribution of agricultural produce and of goods

from other resource zones in the *mauka–makai* network (e.g., fish, forest products) by chiefs must have been necessary periodically during the earliest days, as well as during later droughts, devastating storms, and other periods of hardship. Collection and redistribution of goods by leaders has traditionally provided, in Indo-Pacific areas and around the world, both a major stimulus toward the institutionalized centralization of economic and political control and the infrastructure for their conduct (e.g., Allen 1988, 1990*b*; Earle 1977; Hutterer 1973; Kennedy 1977; Kirch 1984). In Hawai'i, it appears likely that economic centralization and redistribution of goods including agricultural produce facilitated the evolution of the autonomous self-supporting *ahupua'a* and, ultimately, that of the district- and island-wide states.

The agricultural fields of Hawai'i have been investigated primarily at the level of the individual site—a field or family-associated field complex. The existence of huge numbers of fields across large segments of the landscape has often been explained only in terms of increased needs for foodstuffs due to population pressure. But Hawaiian agriculture, as Kirch (1984:13–15) points out, was not simply subsistence-oriented. It functioned within a complex cultural system that eventually required the production of large quantities of foodstuffs for purposes well beyond simple subsistence.

At the individual level, the efficient exploitation of a specialized niche (e.g., irrigated agricultural fields) within a heterogeneous *mauka–makai* economic landscape produces craft specialization, by which I mean two things: the full-time employment of certain members of society in the manufacture or production of a specialized item, rather than in generalized subsistence activities; and the skilled production of this item not just for "auto-consumption" (Brookfield 1972:38) in the immediate household, but for social purposes or exchange (reciprocal, redistributive, or market) beyond family and residential boundaries.

Centralized control over the distribution of goods from a specialized niche generally produces some degree of control over craft performance within that niche. Although terrace construction techniques around the world actually demonstrate great morphological variability (e.g., Spencer and Hale 1961:5–6), the best-documented systems known to have been associated with the emergence of states in the Indo-Pacific region (e.g., South China, peninsular Thailand, Java) exhibit nearly identical construction over extensive areas. Such similar construction appears to reflect standardized technology and use. Centralization of control over agricultural craft performance in pre-Contact O'ahu is visible as evidence for standardized terrace construction and use.

In Polynesia, extensive terrace complexes in both the Society and Marquesas archipelagoes, whose peoples are credited with settling Hawai'i, appear associated with centralized societies. In Hawai'i, there is ample evidence (archaeological, ethnohistorical, and chronometric) to suggest that the terraces of O'ahu reflect centralized control, perhaps in its earliest stages.

O'ahu's irrigated taro fields, in addition to supplying a vitally important commodity to each redistributive exchange network and demonstrating standardized construction and use, participated in another way in the evolution of sociopolitical complexity. The construction and use of the hydraulic networks that were necessary to provide them with water required careful coordination. In contrast with the results of Kappel's (1974) ethnographic study, the radiocarbon-dated Hawaiian

evidence suggests that irrigation contributed far more importantly to political evolution than did population pressure, which became a factor only late in the transformation process.

To provide fresh, flowing water to taro plants growing in pondfield complexes, major streams were partially dammed and *'auwai* excavated to divert stream waters into adjacent terraced fields. Water needed by residents and cultivators in downstream areas was therefore removed. To protect the rights of those living and farming in all reaches of a stream, effective customs, and then laws, were devised regarding appropriate and inappropriate uses of water. "*Wai*" in Hawaiian means fresh water; "*waiwai*" means wealth, property, prosperity, ownership, possession. And "*kānāwai*" is the Hawaiian word for "law" (Handy and Handy 1972:57–58; Pukui and Elbert 1971).

Cooperation in the use of irrigation water is documented not only legally but also archaeologically and historically. Spencer (1974:60) points out that the appearance of a continuous series of terraces over a local landscape is misleading: each apparent continuum actually consists of small, independent irrigation units, which are coordinated to allow water into each unit as appropriate.

As Handy and Handy explain:

> The building and maintenance of flooded terraces (*lo'i*) and of the irrigation ditches (*'auwai*) were communal procedures. This type of work would certainly never have been achieved had the old Hawaiians done their farming on an individualistic basis, without the planning and direction of proprietary chiefs (*ali'i*) (1972:58).

Handy and Handy state further, for the late post-Contact era, and quoting another source (Judge Antonio Perry, in Thrum's *Hawaiian Annual*, 1913):

> Each large *'auwai* was given the name of the chief or of the land most prominently connected with the undertaking. In the digging of one of the more recent ditches, the Paki *'auwai* . . . in Nuuanu Valley [O'ahu], and so named because the chief Paki planned it and directed its construction, 700 men were employed, 300 being furnished by Paki, 300 by the chief Kehikili and 50 each by Huakini and Dr. Rooke. The work was completed in three days.

As discussed below, standardized pondfield construction techniques and coordinated water use are reflected at agricultural sites throughout Kailua and Kāne'ohe.

THE FIELD SYSTEMS

The large, abandoned agricultural complexes of Kailua and Kāne'ohe (Fig. 1) are impressive in their own right as hydraulic and architectural—perhaps even monumental—features. One of the three sites that produced the evidence discussed here is located in upland Kāne'ohe *ahupua'a* beside Luluku Stream in Luluku (Allen, ed. 1987). The other two are in Kailua *ahupua'a*: Maunawili Stream valley and its major tributaries 'Ōma'o, 'Ainoni, Makawao, and Olomana streams (Allen in prep.); and Kawai Nui Marsh, which is fed by Maunawili Stream (Allen in press; Allen-Wheeler 1981; Cordy 1977, 1978). The data reported were collected primarily from pondfield complexes but include certain evidence from dryland (nonirrigated) fields and fields in Maunawili that apparently used both technologies as necessary.

Dates from Agricultural Contexts

Few agricultural contexts were directly dated until recently; earlier research focused on other site types (e.g., house sites). Adjacent agricultural features were often assumed to be contemporaneous with those sites, a correlation that is now proving in many cases to be spurious.

A small but growing body of radiocarbon dates (as well as lithic, sedimentary, pedological, pollen, and macrobotanical evidence) collected directly from agricultural fields now exists (e.g., Allen in press, in prep.; Allen, ed. 1987; Ayres 1970; Cordy 1978; Kirch and Kelly 1975; Yen et al. 1972). This direct evidence is used here to investigate when sociopolitical centralization occurred in pre-Contact Hawai'i.

Hommon (1976) has presented a three-phase model for Hawaiian sociopolitical development. Phase I (Colonization and Coastal Settlements) lasted from ca. A.D. 500 to A.D. 1400. Phase II, which lasted only two centuries, from A.D. 1400 to 1600, is the period of "initial large-scale expansion into the inland zone, the development of the *ahupua'a* system and the disintegration of the archaic *maka'ainana*" (Hommon 1986:60). Phase III, from A.D. 1600 to Contact in 1778, is the period of major political expansion and the emergence of the state system of government. The Kailua and Kāne'ohe sites represent primarily Phases I and II.

The most extensive dating evidence comes from Site 50-Oa-G5-85 (Bishop Museum numbering system) in Luluku. Two distinct field sets and sequences at this site are described here in some detail, to introduce certain characteristics found in all three study areas.

The two main sets of surface features—one set upstream, the other a short distance downstream—represent only the most recent fields in two long sequences of cut-and-fill terraces that have climbed the slope here for as long as 1500 years. No surface terrace has thus far produced datable material, apparently because modern fertilizers and herbicides used in the area have destroyed or translocated all charcoal and any other organics present during the premodern era.

In the upstream set, which exhibits traditional construction techniques (to be discussed), the master sequence begins with a dryland field (Layer VII) cut into the colluvial slope sometime between A.D. 1235 and 1415 (all radiocarbon dates processed by Beta Analytic, Inc., unless otherwise noted; calibrations after Klein et al. 1982). The sequence includes three datable pondfield soils: Layer VI (A.D. 1265–1405); Layer V (A.D. 1325–1425); and Layer III, which produced two date ranges, A.D. 1435–1665 and A.D. 1415–1805. The later association is incorrect, probably reflecting leaching of Layer I charcoal downward in the column. An *'auwai* (a water control ditch) overlies Layer V and apparently served Layer III. One excavation in this upstream set revealed an additional pondfield, Layer VIII, which produced an anomalous date range (A.D. 1645–1950), apparently reflecting stream contamination; and two Layer VI date ranges, A.D. 1250–1430 and A.D. 1490–1950.

The downstream Luluku sequence begins, over an old stream meander, with a pondfield (Layer VIII) that produced two early radiocarbon date ranges, A.D. 235–620 and A.D. 440–910, and a questionable late one, A.D. 1405–1950, processed by Teledyne Isotopes. The sequence includes three later pondfield layers: Layer VI (A.D. 1045–1340 [Teledyne] and A.D. 1390–1950 [Teledyne]); Layer III (A.D. 1340–1645); and Layer I, undatable. A second excavation unit produced an A.D. 1245–1425 Layer III date range.

TABLE 1. SUGGESTED SEQUENCES, LULUKU AND MAUNAWILI AGRICULTURAL FIELDS

SET	LAYER	ERA/CENTURY (C.)
Luluku, upstream	I	historic era
	III	mid-15th to 18th c.
	V	early 15th c.
	VI	late 14th c.
	VII	mid-14th c.
Luluku, downstream	I	historic era
	III	14th to 15th c.
	VI	11th to 13th c.
	VIII	6th to early 10th c.
Maunawili	cultivation	10th to 17th c.; into historic era
	cultivation: largest area	15th c.

Maunawili's pondfield terrace sequences typically demonstrate use during only one or two periods. Site 50-Oa-G6-70 produced an A.D. 895–1255 range; Site G6-68, A.D. 920–1290; Site G6-55, A.D. 1315–1520 and post-1655; Site G6-48, probably A.D. 1395–1660 and A.D. 1405–1665; and Site G6-69, "modern." At Site G6-44, another dryland agricultural soil sample produced a modern date. At Sites G6-49 and G6-51, two agricultural layers that were probably ponded for short periods produced, respectively, A.D. 1200–1405 and A.D. 1400–1525 date ranges.

In the Kawai Nui Marsh floor, one buried pondfield at Site 50-Oa-G6-39 dates to A.D. 1260–1485; another, post-1430. A volcanic glass hydration sample from a buried taro pondfield wall produced an A.D. 1738 date (Cordy 1978). The marsh fields were planted in Chinese rice—the fields plowed by water buffalo—after 1860.

Too few fields have been dated in the marsh to project a sequence. Table 1 presents the postulated sequences for the other sites.

The buried field systems in Maunawili, Kawai Nui Marsh, and Luluku predate A.D. 1600 and the period of state development, following Hommon's model. The majority of the terraces at Luluku's Site G5-85 and several extensive pondfield terrace complexes in Maunawili and Kawai Nui were almost certainly under cultivation by the fifteenth century; their cultivation may have figured importantly in the development of the *ahupua'a* socioeconomic system.

The Irrigation Networks

The best evidence for the management and coordination of Hawaiian agricultural systems at a level above that of the cultivators themselves should eventually come from the irrigation networks that supplied pondfields with fresh water.

Spencer (1974) reserves the term "irrigation" for artificially watered fields in dry regions, referring to hydraulic technologies used in the humid hill regions of, for example, Southeast Asia and Oceania, as "water control" systems. He makes the important distinction that the water in humid area systems is returned to the streams, with relatively little loss, after being dispersed through the fields. The ability of such water control systems to repay nearly all the water they removed from the streams may help to explain the popularity of irrigated complexes in Hawai'i, even in windward areas that received rainfall adequate for most cultivation.

Hawaiian irrigation technologies have been assigned to morphological types by several researchers (Kirch 1977; Riley 1975; also Allen, ed. 1987:Table 30), based on their differential distribution of stream waters. Type I, thus far undatable, relies on terraces built directly across upland tributaries. The more complex types (II–V), which account for all known networks at the sites under discussion, divert water from major streams. These four types required management and coordination of water rights, as they used water flowing into or through major watersheds, through some of the most fertile and most intensively exploited land in the Hawaiian Islands. It is hoped that certain types will someday be assignable to specific periods in Hawaiian prehistory.

Radiocarbon-dating Hawai'i's water control features has, however, thus far proven difficult, apparently because most evidence washes away during use or after abandonment. As mentioned, a single *'auwai* sectioned in the upstream terrace set in Luluku overlies Layer V, dated to A.D. 1325–1425, and therefore postdates that layer. The *'auwai* appears associated with a network of the most elaborate type (V), served Layer III fields, probably dates to the mid-fifteenth or early sixteenth century, and is assigned to Hommon's Phase II.

The problems encountered in attempts to date the irrigation features of Hawai'i need resolution: as suggested, the control of water is the aspect of pondfield construction and management that most convincingly suggests centralized economic and political control. Wittfogel's (1957) "hydraulic society" may be an oversimplification, but he was correct in his claim that the control of water is vital to the development of complex societies in areas involved in irrigated agriculture.

Standardized Terrace Construction

Better-dated evidence for centralized control is provided by the Kailua and Kāne'ohe agricultural terraces themselves. Surface and buried terrace walls in these complexes reflect nearly identical construction and use, as demonstrated by structural and soil characteristics, and suggest direct control at a supralocal level, manifested as standardized technology.

The upstream and downstream surface terrace sets in Luluku are distinct in several ways. The upstream set has been cultivated under banana since before 1950; the downstream set has not been cultivated since 1928 at the latest (U.S. Geological Survey n.d.) and was completely hidden under dense, mature *hau* (*Hibiscus tiliaceus*, an indigenous hibiscus) when discovered during our reconnaissance survey in 1985; the vegetation has since been cleared (many times).

The two sets were awarded to different people during the mid-nineteenth-century redistribution of lands in fee simple: the upstream set belonged to Kekane (or Kikane), the downstream set to Makaiohua (*Indices of Awards* 1929; Wall 1910). Both men claimed taro *lo'i*.

The traditionally built terraces in the upstream set (Pl. I*a*) and the dominant type in Maunawili demonstrate highly skilled and remarkably consistent construction. Facing construction typically began with a basal course of large, tabular boulders inserted securely, long axis into the slope, in lozenge fashion. Upper courses of carefully sized and carefully fitted small boulders and cobbles were stacked against the slope, with a 70–75° batter angle, for maximum stability. Most facings are only 50–70 cm high and incorporate only five or six rock courses.

Pl. I. *a*. Traditional terrace construction, Site 50-Oa-G5-85, Feature 75, Luluku. Note well-sorted and well-fitted cobbles, low terrace height (0.55 m), and secure batter angle. BMus Neg. No. Oa(a)-285-21. *b*. Nontraditional terrace construction, Site 50-Oa-G5-85, Feature 31, Luluku. Note poorly sorted and poorly fitted rocks, terrace height around 0.90 m, unstable batter angle. BMus Neg. No. Oa(a)-281-30.

Typical terrace size (approximately 148 m^2 in Luluku) is relatively small and manageable, allowing good hydraulic control, and facilitating repairs in the case of flood damage.

Three buried facings in the upstream Luluku set, associated with Layers V, VI, and VIII and probably assignable to the fourteenth to fifteenth centuries, show traditional construction like that of the surface facings.

The only clear connection between these terraces and the downstream Luluku terraces, whether surface or buried, is the use of basal boulders in each facing.

The terraces in the downstream set (Pl. Ib), although also exhibiting standardized traits, appear carelessly constructed. The facings are typically too vertical for stability: some exceed 1.0 m in height, and several contain up to ten courses of poorly sorted and poorly fitted boulders and cobbles.

Field area is typically very large (223 m^2)—75 m^2 larger than the upstream average and too large for effective hydraulic control in heavy rains (water would gain too much momentum on each terrace, eroding facings and field soils).

One dated terrace (Layer I) in the downstream set definitely postdates A.D. 1390 and may postdate A.D. 1600. These terraces might even date to the initial historic period, when the Hawaiian states were increasingly influenced by foreigners, and when Kamehameha I needed large numbers of supplies for the developing exchange with foreign ships' captains. Compared to the carefully built upstream terraces, they demonstrate haste in construction and a lack of craft excellence. Perhaps they reflect a strained, over-centralized government at its limit of efficiency.

A wall built of poorly fitted boulders in the Kawai Nui Marsh complex, volcanic glass-dated to A.D. 1738, resembles the downstream Luluku facings.

Traditional construction like that described for the upstream terraces in Luluku is reflected in surface and subsurface terraces throughout Maunawili and in other O'ahu complexes including Mākaha (Yen et al. 1972:77); and in surface sets on both O'ahu (e.g., Kahana, Anahulu valleys) and other islands (e.g., Hālawa, Moloka'i). Such close similarity suggests island-wide craft standardization and supervision at some point relatively late in the pre-Contact period.

Table 2 lists the radiocarbon date ranges for all Luluku and Maunawili layers known to be associated with facings of the standard type. Of thirteen date ranges associated with both traditional construction techniques and longterm irrigation, one belongs to Hommon's (1976) Phase I; one, to Phase I or initial Phase II; three, to Phase I or II; one, to the period between late Phase I and initial Phase III; and four, to Phase II or III. Only two ranges—one definitely incorrect—fit entirely within Phase III, the period of state development. The final "modern" date is also incorrect.

To summarize these findings, five of the ranges predate Phase III, and a sixth probably does so. Four others might predate Phase III. Only one range, from Site G6-55, appears securely assignable to Phase III.

Three additional Phase I terraces, for which facings have not yet been discovered, provided the following date ranges: A.D. 235–620 and 440–910 for Site G5-85 Layer VIII; and A.D. 895–1255 for Site G6-70 Layer V.

The five earliest dates in Luluku and Maunawili come from inland areas located near the forest edge, beside major streams or their tributaries. Location near the stream valley/forest interface, where both agricultural and forest products could be collected, made these areas optimal for inland expansion during even the earliest

TABLE 2. DATED CONTEXTS ASSOCIATED WITH TRADITIONAL FACINGS

	SITE	LAYER	TIME PERIOD (A.D.)
Luluku, upstream	50-Oa-G5-85	III	1435–1665
			1415–1805
		V	1325–1425
		VI	1265–1405
			1250–1430
			1490–1950
		VIII	1645–1950
			(incorrect)
Maunawili	50-Oa-G6-48	IIa	1405–1665
		IIb	1395–1660
	50-Oa-G6-55	IIb	1655–1950
		IIc	1315–1520
	50-Oa-G6-68	II	920–1290
	50-Oa-G6-69	IIc	Modern (incorrect)

days of Polynesian occupation. Any initial exchange in these items was probably reciprocal, between family members.

These five earliest terraces predate, in Hommon's model, not only the development of the state but probably also the establishment of its precursor, the *ahupua'a* system. Some level of centralized control by A.D. 1405 is suggested by standardized construction in two of the five terraces. Centralized management of water use was critical in all five cases.

The Phase II and Phase III terraces are located in prime agricultural land near the forest. All relied on irrigation water from major streams. Except for Site G6-69, which produced a "modern" date, and one upper layer (IIb) at Site G6-55, the median dates for all the pondfields discussed suggest supervision and standardization long before A.D. 1600.

Taro Pondfields as an Administrative Support Base

As previously mentioned, O'ahu's surface pondfield complexes were capable of producing huge amounts of taro. Rather than providing subsistence for a dense cultivator population, as has formerly been suggested, this large-scale production included large surpluses. Economic and political centralization typically generates increased numbers and levels of overseers and other administrators who do not produce their own food. Extra food had to be produced by the society's primary producers, the farmers and fisherfolk, for two main purposes: to feed the members of this elaborated hierarchy of non-producing administrators; and to supply rents, taxes, and ritual offerings for use at festivals and ceremonies that helped to legitimize the administration.

It is not yet known whether most buried pondfield complexes on O'ahu were as extensive as their surface components. The evidence from Luluku indicates, however, that the upstream and downstream sets reached their current sizes by A.D. 1350 or 1400. The less complete Maunawili evidence suggests expansion to current boundaries at Sites G6-48 and G6-55 by A.D. 1400–1500. In Kawai Nui, cultivation had expanded into formerly marshy bottomland locations by A.D. 1400 or so.

Supralocal control and institutionalized surplus production for administrative needs appear to have been in place by A.D. 1400, fully two centuries before the transition to the traditional Hawaiian state.

CONCLUSION

The arguments presented here, although based on a small data base, suggest that archaeological data from agricultural contexts can contribute significantly to our understanding of economic and political process in Hawai'i. The data base is fortunately still expandable, for, whereas many sites of other types have been destroyed over the past thirty years, agricultural areas have benefitted until recently from benign neglect on the parts of both developers and archaeologists. Even now, although agricultural areas are disappearing more rapidly, large terrace complexes remain available for study.

Three main types of data have been discussed: evidence for coordinated irrigation networks; uniform and apparently standardized terrace construction styles and techniques; and the potential of O'ahu's fields to produce large taro surpluses, which were needed to feed non-producing administrators and for ritual and political purposes.

The evidence from Luluku, Kawai Nui, and Maunawili suggests that:

1) pondfield cultivation in windward O'ahu began in areas at the forest edge, where both forest and agricultural products could be collected for exchange;

2) agricultural production became standardized in some upland areas (e.g., Site G6-68) as early as A.D. 1000, suggesting developing centralization and involvement in a redistributive economic network;

3) agricultural construction and production in areas along major streams were coordinated at a supralocal level by A.D. 1400, probably predating and contributing to the emergence of the *ahupua'a* system of land division and administration;

4) production of taro surpluses by A.D. 1400 reflects the centralized control of agriculture not only for economic reasons but to ensure that a support base existed for administrators in an elaborated political hierarchy; and

5) coordination of elaborate water distribution networks that used water from main streams for agricultural purposes is reflected before A.D. 1500 and probably contributed to the development of the *ahupua'a* system, predating the development of the state system of government and codification of the Hawaiian legal system.

Economic centralization integrated Hawaiian society, maintaining interdependence and fostering solidarity in the political unit. Taro, always one of the most important economic products in Hawai'i, was ultimately collected as taxes, rent, and share-cropping levies. It was sacrificed at *heiau*. And it formed a central material focus at *makahiki* festivals, where the people were brought together, social and political ties were strengthened, and the redistributive process and centralized political control were reinforced. Such ceremonies demonstrated the ability of the ruler to collect large quantities of produce; disseminated appropriate ideas and information; and enhanced the leader's power and opportunities for future influence.

O'ahu's pondfields, which provided much of the produce distributed at these festivals, must be understood first and foremost as a critical component in each *mauka–makai* network on the island. The systematization of pondfield agriculture

contributed importantly to the incorporation of *mauka–makai* networks within *ahupua'a*, and, eventually, within a social, political, and economic unit that included the entire island—and state—of O'ahu.

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